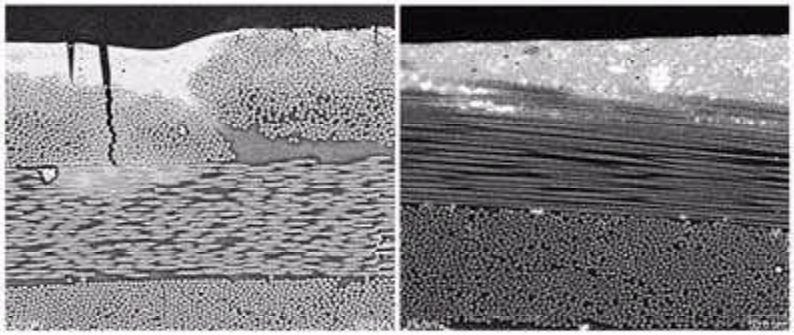
Polymer/Silicate Nanocomposites Developed for Improved Strength and Thermal Stability

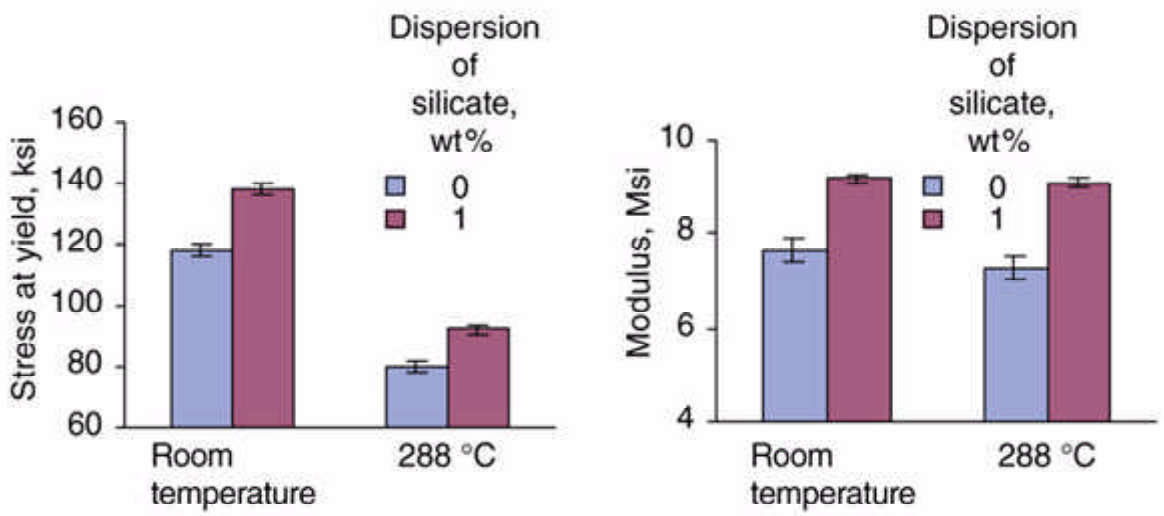
Over the past decade, polymer-silicate nanocomposites have been attracting considerable attention as a method of enhancing polymer properties. The nanometer dimensions of the dispersed silicate reinforcement can greatly improve the mechanical, thermal, and gas barrier properties of a polymer matrix.

In a study at the NASA Glenn Research Center, the dispersion of small amounts (< 5 wt%) of an organically modified layered silicate (OLS) into the polymer matrix of a carbon-fiber-reinforced composite has improved the thermal stability of the composite. The enhanced barrier properties of the polymer-clay hybrid are believed to slow the diffusion of oxygen into the bulk polymer, thereby slowing oxidative degradation of the polymer. Electron-backscattering images show cracking of a nanocomposite matrix composite in comparison to a neat resin matrix composite. The images show that dispersion of an OLS into the matrix resin reduces polymer oxidation during aging and reduces the amount of cracking in the matrix significantly.



Electron backscatter images. Left: Neat resin (BAX) matrix composite. Right: Nanocomposite (BAX-2 wt% OLS) matrix composite.

Improvements in composite flexural strength, flexural modulus, and interlaminar shear strength were also obtained with the addition of OLS. An increase of up to 15 percent in these mechanical properties was observed in composites tested at room temperature and 288 °C. The best properties were seen with low silicate levels, 1 to 3 wt%, because of the better dispersion of the silicate in the polymer matrix.



Improvements in strength and modulus with the addition of OLS.

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